3. A decided diurnal variation has been found to exist, the emanation content being considerably greater during the night than during the day. Observations for the interval from 11 p. m. to 5 a. m. gave a mean value 3.31 times greater than the mean value for the interval from 11 a. m. to 5 p. m. This variation has been found to be closely related to the variation in the total wind movement during the period, a high value of the wind movement corresponding to a low value of the emanation content.

4. The rate at which radium emanation is exhaled from the surface of the ground shows a decided decrease after periods of heavy rain. This decrease has been found in some cases to be almost 60 per cent of the rate of exhalation for fair weather.

5. The radium-emanation content of soil gas has been determined for depths of 30, 70, and 120 cm., respectively, and the variation with weather conditions studied. The variation of the radioactivity of the gas from the 30 cm. pipe was found to follow closely the variation in the emanation exhaled, a decrease in the exhalation resulting in a corresponding increase in the emanation content of the ground gas. The 70 cm. and 120 cm. pipes showed only slight variations with the weather conditions. The average value of the emanation content for the gas collected from the 120 cm. pipe was found to be 304.5×10^{-12} grams per liter, or over 4,000 times the mean value for atmospheric air. The mean value for the 30 cm. pipe was only about one-seventh that for the 120 cm. pipe.

METEOROLOGICAL PAPERS PRESENTED AT THE HAVRE MEETING OF THE FRENCH ASSOCIATION.

At the 43d session of the Association Française pour l'Avancement des Sciences, held at Havre in July, 1914, there were presented a number of interesting papers dealing with subjects of interest to the meteorologist. The following abstracts have been translated from the Comptes rendus of the 43d session, Paris, 1915, p. 101, ffg. — C. A., jr.

Reforestation and "occult" condensations.—An abundant and regular supply of water is the vital essential of inland navigation, of the "white coal" [waterpower] supply, and of agriculture. The "occult" condensations dew and white frost, are not recorded by the raingage but they supplement the rainfall with a quantity of water which is controlled and regulated in advance of its precipitation and which would be considerably increased by reforestation. For the quantity of frost (givre) coating a tree at the close of a clear winter night is much greater than the quantity that collected during the same night on a piece of naked ground whose area equals that of the projection of the tree. Reforestation, already serving as an element in the control of the water supply, may therefore be employed to increase the supply of water under man's control, and it is desirable to determine the extent to which reforestation can contribute.

After discussion, the section of the Association resolved that we should undertake studies designed to determine the degree to which reforestation can supplement the water supply by thus reinforcing the "occult" condensations, such as dew and frost.—*Paul Descombes.*

Weather forecasts by Guilbert's rules.—The author called attention to the circumstance that his rules for forecasting (Principes)[1] as published in 1891 have been designated by certain official meteorologists as being "as useless as possible" and "without either scientific or practical value of any kind." Experience alone can decide whether or no these criticisms are exaggerated.

Guilbert's method has now been applied in forecasting for a Parisian journal since October 1, 1912, with the result that the proportion of verifications has been 80 per cent. During the winter semester of 1913–14 this proportion rose to 86 per cent; while the proportion of verifications rose to 89 per cent for those predictions essentially peculiar to his method, viz, the changes in the barometric depressions resulting in their intensification, weakening, or disappearance.

The relation of cause to effect as established by the author between the force-direction of the wind and the consecutive variation in the barometric pressure has proved so exact that it has been possible in many of his forcasts to designate (1) the relative importance of the future barometric change, (2) its location, (3) its limits, and (4) even the name of the station where the barometric rise (hausse barométrique) will attain its maximum. Thus, among all the stations in France, for example, the author has been able to designate the occurrence of this maximum as now at Nantes, now at Nice, or Paris, or Charleville, or at Havre, etc.

This "new method" forecasts every meteorological phenomenon—rain and wind, temperature, fog, thunderstorms, etc.—simultaneously with its principal cause, the pressure change. The new method is, therefore, not merely practical and utilizable but also scientific, since every forecast is made according to principles and rules established on constant facts; moreover, the rules may be applied by every meteorologist. A method that during 21 months has permitted a daily forecast of atmospheric phenomena which meteorological science does not even attempt to foresee, must be regarded as a step in advance and ought to put an end to the existing empiricism of official meteorological forecasts.—*Gabriel Guilbert.*

Barograms and thermograms in relation to cosmical phenomena.—The study of nebulæ leads the author to the supposition that the combustion phenomena [in nebulæ] further the escape of gaseous masses which resemble the matter composing the stars, and that these masses become residual matter in interstellar space.

When comets approach the sun (i. e., approach their perihelion) they undergo quite irregular variations in form and brilliancy; they have been observed (Morehouse) to give off explosions and even to be destroyed (Biéla) by an explosion. All these phenomena are explicable only as due to the influence of an exterior gaseous medium. Therefore, he concludes that the interplanetary spaces of the solar nebulosity, as well as of the others, contain residual gases.

This concept seems to furnish an explanation of meteorological phenomena. While preparing for Le Temps (Paris) the daily temperature- and pressure-curves observed at the observatory Tour Saint-Jacques in Paris, there was noticed a certain parallelism between these simultaneous curves. This parallelism could be very simply explained by referring it to the rising and falling of that upper atmospheric stratum called the "stratosphere." It then becomes necessary to seek the general cause of atmospheric variations in the region above that stratum by ascribing them to the passage of independent gaseous masses that happen to come into contact [with the earth's atmosphere] and are influenced by the terrestrial rotation.

[1] See this REVIEW, May, 1907, 35: 210-212.—EDITOR.

The Bureau Central Météorologique very kindly placed at my disposal the files of its Bulletin, which contains a great mass of accurate material that is very suggestive of the hypothesis when systematically arranged according to the above ideas.—*Jean Meunier.*

Hertzian waves should be observed and continuously recorded.—In November, 1911, the Observatoire Saint-Louis on the Isle of Jersey (Channel Isles) began to maintain a continuous record of electromagnetic waves of atmospheric origin. The recording device, called a *meteorondograph* (*Fr.*, météorondegraphe), involves a specially designed galvanometer which serves as a vibrating relay (relais-trembleur), and the observations are directed more toward determining the intensity rather than the frequency of the waves.

Observations have now been maintained through two complete years, and they permit us to recognize the existence of a normal hertzian field which, in common with all other atmospheric phenomena, is subject to laws of very constant, regular diurnal and annual variations; but it is also subject in common with the terrestrial magnetic field to sudden disturbances of great violence directly related to local or neighboring thunderstorms.

A comparative study at Tortosa, Spain, of observations bearing on the frequency of such waves, has shown that the hertzian field exists there also and shows the same character and law of variation that it does at Jersey.—*Marc Dechevrens.*

Thunderstorm of June 15, 1914 at Paris.—A torrential rainfall accompanied this storm between $17^h\ 40^m$ and $18^h\ 04^m$, giving 41 mm. in 24 minutes; there resulted serious damages to the "Métropolitain" [the Paris Underground] as well as injuries to persons.

The peculiarities of the storm as recorded at the Bureau Central Météorologique were described. The barogram showed a "squall hook" [2] and the wind vane made a complete circuit in the direction NW.–W. [anticlockwise] which is explained by the peculiar form of the barogram. The barometer located at the summit of the Eiffel Tower [not far from the Bureau Central Météorologique] did not record any such sudden change; an interesting relation, since it is in accord with the hypothesis which explains the sudden rise in pressure [causing the "squall hook"] as a dynamic effect produced by the descent of the air in the "squall zone".[3]—

THE GREEN FLASH AT SUNSET.[1]

By ALFRED W. PORTER.

[Dated: University College, London, Feb. 7, 1915.]

So much has been written about the green-ray at sunset that I am somewhat diffident about adding anything. But as I find myself unable to accept the orthodox explanation of the phenomenon usually seen, I write this note. This phenomenon, as seen by me on several occasions during the last summer on my way to Australia, always consisted in the last segment of the red sun before disappearance becoming a bright green (without any transition through intermediate tints); this green was, as nearly as could be judged, the complementary to the red of the sun itself. On one occasion I shut my eyes immediately the green tint appeared and it *remained visible.* There could be no doubt that what I saw was the purely subjective afterimage of the disappearing segment of the sun.

Of course if this is so it should be easy to set up a laboratory experiment to imitate the natural phenomenon; and on returning [to London] I asked Mr. E. Talbot Paris, research student in the Physical Department of this University, to arrange an experiment in illustration. An eccentric hole was made in a disk mounted on an axle. Red glass or gelatin film was fixed over the hole, and a bright light placed behind illuminated the film and produced thereby a miniature sun, which by slow rotation could be made to "set" behind an interposed card. At the exact instant of setting the artificial sun exhibited an exact reproduction of the phenomenon of the green ray. It was easily possible in this way to obtain a red ray using a green sun, or a blue ray with a yellow sun, and so on.

It is easy to give the rationale of the effect. The positive light gradually diminishes as the artificial sun passes below the horizon; and it only requires a little adjustment of the rate of disappearance in order that the negative afterimage excited at a previous instant when the segment was brighter shall overpower the simultaneous weaker positive image of the remaining segment itself.

It would not be fair for me to dogmatize and assert that this is the only phenomenon which comes under the head of the green ray. But it is certainly the only one which I succeeded in seeing; and *it must always be present even on the possible rarer occasions when color changes arising from dispersion are also evident.* It is certainly also what many others saw. At the same time it must also be added that the phenomenon as observed by different persons, even on the same night, was so variously described as to lead one to suppose that the subjective element is sometimes present to even a greater degree than is implied in the above note.

[The interested reader will find the green flash discussed briefly, as a phenomenon of refraction, by H. Schering in this REVIEW, September, 1905, **33**:408.—EDITOR.]

PERNTER AND EXNER ON THE GREEN FLASH.[1]

These authors describe the green-ray as having the color of the emerald, or about wave-length 530$\mu\mu$, and state that sometimes it has been reported to be of blue color. Of recent years it has been reported much more frequently than during the years previous to 1900, probably because more attention has been paid to this phenomenon. The "ray" or "flash" lasts but a few seconds, sometimes only a fraction of a second, and seems to be more frequently observed within than outside the Tropics.—C. A., jr.

The first explanations of the green ray referred it to the phenomena of optical atmospheric refraction which would cause the green, the blue, and the violet rays to be the last ones reaching the observer from the sun as it set below the horizon. Atmospheric extinction tends to blot out the most highly refracted waves—i. e., the blue and the violet—so that there remains a color mixture consisting of the more refrangible portion of the spectrum, viz, pre-

[1] *Reprinted from* Nature (London), Feb. 18, 1915, 94: 672.
[2] *See* Loisel, J. Squalls and thunderstorms. MONTHLY WEATHER REVIEW, June, 1909, 37: 239.
[3] Loisel, op. cit., p. 237.

[1] Pernter & Exner. Meteorologische Optik: IV. Abschnitt (Exner), Wien, 1910, p. 798–799.